Claims:

1. A method of determining edge information for image data comprising a mapping of discrete sample values said method comprising the steps of:

(i) calculating an edge strength value for each of said discrete sample values of said image data to identify edge sample values;

(ii) storing an angle of orientation for each of said edge sample values; and

(iii) manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process.

2. The method according to claim 1, wherein step (i) includes the further sub-steps:

calculating an edge indicator value, C; and

comparing said edge indicator value with a plurality of threshold values, wherein said edge strength value of each said discrete sample value is based on said comparisons.

3. The method according to claim 2, wherein said edge indicator, C, is of the form:

$$C = \max(|Y_0 - Y_i|), \quad i \in 1,..,8$$

and wherein i is an index of the 8 nearest neighbour discrete sample values of a centre discrete sample value, Y_0.

4. The method according to claim 2, comprising the further step of determining said angle of orientation for each of said edge sample values.

5. The method according to claim 1, wherein said morphological process is a cleaning operation performed on said discrete sample values.

6. The method according to claim 5, wherein said cleaning operation is a morphological opening operation followed by a morphological closing operation.

7. A method of interpolating image data comprising a first mapping of discrete sample values, said method comprising the steps of:

(i) calculating edge information for each of said discrete sample values of said image data to identify edge sample values and storing an angle of orientation and an edge strength value for each of said edge sample values;

(ii) manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process;

(iii) combining said manipulated edge sample values and said manipulated angle of orientation for each of said discrete sample values to form a second mapping of said discrete sample values;

(iv) mapping said manipulated edge sample values of said second mapping, using a mapping function, to form a third mapping;

(v) for each discrete sample value of said third mapping:

(i) calculating parameters of a kernel, wherein said parameters are dependant upon said edge sample values and said angle of orientation of each of said sample values of said third mapping;

(ii) calculating a plurality of kernel values utilising said parameters and said kernel; and

(vi) convolving said plurality of kernel values with said first mapping of discrete sample values to form a fourth mapping of discrete sample values.

8. The method according to claim 7, wherein said steps (i) to (vi) are carried out on at least one of a plurality of portions of said first mapping of discrete sample values of said image data.

9. The method according to claim 7, wherein said fourth mapping is at a different resolution to said first mapping.

10. The method according to claim 7, wherein said image data is colour image data.

11. The method according to claim 10, wherein said steps (i) to (vi) are carried out for each colour plane of said colour image data.

12. The method according to claim 7, wherein step (i) is carried out in a first colour plane and step (v) is carried out in a plurality of colour planes.

13. The method according to claim 7, wherein step (i) includes the further sub-steps:

calculating an edge indicator value, C, as said edge information; and

comparing said edge indicator value with a plurality of threshold values, wherein said labelling of each discrete sample value is based on said comparisons.

14. The method according to claim 13, wherein said edge indicator, C, is of the form:
$C = \max(|Y_0 - Y_i|), \quad i \in 1,..,8$

and wherein i is an index of the 8 nearest neighbour discrete sample values of a centre discrete sample value, Y_0.

15. The method according to claim 1 3, comprising the further step of determining said angle of orientation for each of said edge sample values.

16. The method according to claim 7, wherein said morphological process is a cleaning operation performed on said discrete sample values.

17. The method according to claim 16, wherein said cleaning operation is a morphological opening operation followed by a morphological closing operation.

18. The method according to claim 7, wherein said mapping function is a nearest neighbour mapping function.

19. The method according to claim 7, wherein said kernel is a universal interpolation kernel, *h(s)*.

20. The method according to claim 19, wherein said universal interpolation kernel is of the form:

$$h(s_x, s_y)_{0\le\theta\le\pi/2} = \frac{1}{\sqrt{2}}\left\{h\left((1-2\theta/\pi)s_x + (2\theta/\pi)s_y\right)_{c=0.5} \cdot h\left(((2\theta/\pi)s_x + (2\theta/\pi - 1)s_y)w(\theta)\right)_{c=0}\right\}$$

$$h(s_x, s_y)_{\pi/2<\theta<\pi} = \frac{1}{\sqrt{2}}\left\{h\left((2\theta/\pi - 1)s_x + (2\theta/\pi - 2)s_y\right)_{c=0.5} \cdot h\left(((2\theta/\pi - 2)s_x + (1-2\theta/\pi)s_y)w(\theta)\right)_{c=0}\right\}$$

,

wherein *h(s)* is defined as:

$$h(s)=\begin{cases}1, & 0\le|s|\le d\\ (2-\frac{3}{2}b-c)\left|\frac{s-d}{1-2d}\right|^3+(-3+2b+c)\left|\frac{s-d}{1-2d}\right|^2+(1-\frac{1}{3}b), & d<|s|\le 1-d\\ 0, & 1-d<|s|\le 1+d\\ (-\frac{1}{6}b-c)\left|\frac{s-3d}{1-2d}\right|^3+(b+5c)\left|\frac{s-3d}{1-2d}\right|^2+(-2b-8c)\left|\frac{s-3d}{1-2d}\right|+(\frac{4}{3}b+4c), & 1+d<|s|\le 2-d\\ 0, & \textit{Otherwise}\end{cases}$$

and wherein $s = t/\Delta t$ and $0 \le d < 0.5$.

21. The method according to claim 7, wherein said kernel is a cubic interpolation kernel, *h(s)*.

22. The method according to claim 21, wherein said cubic interpolation kernel, *h(s)*, is of the form:

$$h(s)=\begin{cases}(2-\frac{3}{2}b-c)|s|^3+(-3+2b+c)|s|^2+(1-\frac{1}{3}b), & |s|\le 1\\ (-\frac{1}{6}b-c)|s|^3+(b+5c)|s|^2+(-2b-8c)|s|+(\frac{4}{3}b+4c), & 1<|s|\le 2\\ 0, & \textit{Otherwise}\end{cases}$$

and wherein $b = 0$ and $c = 0.5$.

23. The method according to claim 7, wherein said kernel is a linear interpolation kernel.

24. The method according to claim 7, wherein said kernel is a universal linear interpolation kernel.

25. The method according to claim 7, wherein said kernel is a quadratic interpolation kernel.

26. The method according to claim 7, wherein said kernel is a weighted sinc interpolation kernel.

27. A method of performing interpolation on a pixel-based image, said method comprising the steps of:

accessing a first set of discrete sample values of said image data;

calculating kernel values for each of said discrete sample values using a kernel, wherein parameters of said kernel are selected depending upon an edge orientation indicator, an edge strength indicator, and an edge context indicator for each of said discrete sample values; and

convolving said kernel values with said discrete sample values to provide a second set of discrete sample values.

28. A method of interpolating a first set of discrete sample values to generate a second set of discrete sample values using an interpolation kernel, wherein parameters of said interpolation kernel are selected depending on an edge strength indicator, an edge direction indicator and an edge context indicator for each discrete sample value of said first set.

29. An apparatus for determining edge information for image data comprising a mapping of discrete sample values, said apparatus comprising:

calculation means for calculating an edge strength value for each of said discrete sample values of said image data to identify edge sample values;

storage means for storing an angle of orientation for each of said edge sample values; and

manipulation means for manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process.

30. The apparatus according to claim 29, wherein said calculation means calculates an edge indicator value, C, and compares said edge indicator value with a plurality of threshold values, wherein said edge strength value of each said discrete sample value is based on said comparisons.

31. The apparatus according to claim 30, wherein said edge indicator, C, is of the form:
$C = \max(|Y_0 - Y_i|), \quad i \in 1,..,8$

and wherein i is an index of the 8 nearest neighbour discrete sample values of a centre discrete sample value, Y_0.

32. The apparatus according to claim 30, further comprising means for determining said angle of orientation for each of said edge sample values.

33. The apparatus according to claim 29, wherein said morphological process is a cleaning operation performed on said discrete sample values.

34. The apparatus according to claim 33, wherein said cleaning operation is a morphological opening operation followed by a morphological closing operation.

35. An apparatus for interpolating image data comprising a first mapping of discrete sample values, said apparatus comprising:

first calculation means for calculating edge information for each of said discrete sample values of said image data to identify edge sample values and storing an angle of orientation and an edge strength value for each of said edge sample values;

manipulation means for manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process;

combination means for combining said manipulated edge sample values and said manipulated angle of orientation for each of said discrete sample values to form a second mapping of said discrete sample values;

mapping means for mapping said manipulated edge sample values of said second mapping, using a mapping function, to form a third mapping;

second calculation means for calculating parameters of a kernel for each discrete sample value of said third mapping, wherein said parameters are dependant upon said edge sample values and said angle of orientation of each of said sample values of said third mapping, and for calculating a plurality of kernel values utilising said parameters and said kernel; and

convolution means for convolving said plurality of kernel values with said first mapping of discrete sample values to form a fourth mapping of discrete sample values.

36. The apparatus according to claim 35, wherein said fourth mapping is at a different resolution to said first mapping.

37. The apparatus according to claim 35, wherein said image data is colour image data.

38. An apparatus for performing interpolation on a pixel-based image, said apparatus comprising:

accessing means for accessing a first set of discrete sample values of said image data;

calculation means for calculating kernel values for each of said discrete sample values using a kernel, wherein parameters of said kernel are selected depending upon an edge orientation indicator, an edge strength indicator, and an edge context indicator for each of said discrete sample values; and

convolution means for convolving said kernel values with said discrete sample values to provide a second set of discrete sample values.

39. An apparatus for interpolating a first set of discrete sample values to generate a second set of discrete sample values using an interpolation kernel, wherein parameters of said interpolation kernel are selected depending on an edge strength indicator, an edge direction indicator and an edge context indicator for each discrete sample value of said first set.

40. A computer readable medium, having a program recorded thereon, where the program is configured to make a computer execute a procedure to determine edge information for image data comprising a mapping of discrete sample values, said program comprising:

code for calculating an edge strength value for each of said discrete sample values of said image data to identify edge sample values;

code for storing an angle of orientation for each of said edge sample values; and

code for manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process.

41. The computer readable medium according to claim 40, further comprising:

code for calculating an edge indicator value, C; and

code for comparing said edge indicator value with a plurality of threshold values, wherein said edge strength value of each said discrete sample value is based on said comparisons.

42. The computer readable medium according to claim 41, wherein said edge indicator, C, is of the form:

$$C = \max(|Y_0 - Y_i|), \quad i \in 1,..,8$$

and wherein i is an index of the 8 nearest neighbour discrete sample values of a centre discrete sample value, Y_0.

43. The computer readable medium according to claim 41, further comprising code for determining said angle of orientation for each of said edge sample values.

44. The computer readable medium according to claim 40, wherein said morphological process is a cleaning operation performed on said discrete sample values.

45. The computer readable medium according to claim 44, wherein said cleaning operation is a morphological opening operation followed by a morphological closing operation.

46. A computer readable medium, having a program recorded thereon, where the program is configured to make a computer execute a procedure to interpolate image data comprising a first mapping of discrete sample values, said program comprising:

code for calculating edge information for each of said discrete sample values of said image data to identify edge sample values and storing an angle of orientation and an edge strength value for each of said edge sample values;

code for manipulating said edge sample values and said stored angle of orientation for each of said discrete sample values using a morphological process;

code for combining said manipulated edge sample values and said manipulated angle of orientation for each of said discrete sample values to form a second mapping of said discrete sample values;

code for mapping said manipulated edge sample values of said second mapping, using a mapping function, to form a third mapping, wherein for each discrete sample value of said third mapping, said program comprises code for calculating parameters of a kernel, wherein said parameters are dependant upon said edge sample values and said angle of orientation of each of said sample values of said third mapping, and for calculating a plurality of kernel values utilising said parameters and said kernel; and

code for convolving said plurality of kernel values with said first mapping of discrete sample values to form a fourth mapping of discrete sample values.

47. The computer readable medium according to claim 46, wherein said fourth mapping is at a different resolution to said first mapping.

48. The computer readable medium according to claim 46, wherein said image data is colour image data.

49. The computer readable medium according to claim 46, further comprising:
code for calculating an edge indicator value, C, as said edge information; and
code for comparing said edge indicator value with a plurality of threshold values, wherein said labelling of each discrete sample value is based on said comparisons.

50. The computer readable medium according to claim 49, wherein said edge indicator, C, is of the form:

$$C = \max(|Y_0 - Y_i|), \quad i \in 1,..,8$$

and wherein i is an index of the 8 nearest neighbour discrete sample values of a centre discrete sample value, Y_0.

51. The computer readable medium according to claim 49, further comprising code for determining said angle of orientation for each of said edge sample values.

52. The computer readable medium according to claim 46, wherein said morphological process is a cleaning operation performed on said discrete sample values.

53. The computer readable medium according to claim 52, wherein said cleaning operation is a morphological opening operation followed by a morphological closing operation.

54. The computer readable medium according to claim 46, wherein said mapping function is a nearest neighbour mapping function.

55. The computer readable medium according to claim 46, wherein said kernel is a universal interpolation kernel, *h(s)*.

56. The computer readable medium according to claim 54, wherein said universal interpolation kernel is of the form:

$$h(s_x,s_y)_{0\le\theta\le\pi/2}=\frac{1}{\sqrt{2}}\left\{h\left((1-2\theta/\pi)s_x+(2\theta/\pi)s_y\right)_{c=0.5}\cdot h\left(((2\theta/\pi)s_x+(2\theta/\pi-1)s_y)w(\theta)\right)_{c=0}\right\}$$

$$h(s_x,s_y)_{\pi/2<\theta<\pi}=\frac{1}{\sqrt{2}}\left\{h\left((2\theta/\pi-1)s_x+(2\theta/\pi-2)s_y\right)_{c=0.5}\cdot h\left(((2\theta/\pi-2)s_x+(1-2\theta/\pi)s_y)w(\theta)\right)_{c=0}\right\}$$

,

wherein *h(s)* is defined as:

$$h(s)=\begin{cases}1, & 0\le|s|\le d\\ (2-\frac{3}{2}b-c)\left|\frac{s-d}{1-2d}\right|^3+(-3+2b+c)\left|\frac{s-d}{1-2d}\right|^2+(1-\frac{1}{3}b), & d<|s|\le 1-d\\ 0, & 1-d<|s|\le 1+d\\ (-\frac{1}{6}b-c)\left|\frac{s-3d}{1-2d}\right|^3+(b+5c)\left|\frac{s-3d}{1-2d}\right|^2+(-2b-8c)\left|\frac{s-3d}{1-2d}\right|+(\frac{4}{3}b+4c), & 1+d<|s|\le 2-d\\ 0, & \textit{Otherwise}\end{cases}$$

and wherein $s=t/\Delta t$ and $0\le d<0.5$.

57. The computer readable medium according to claim 46, wherein said kernel is a cubic interpolation kernel, *h(s)*.

58. The computer readable medium according to claim 56, wherein said cubic interpolation kernel, *h(s)*, is of the form:

$$h(s)=\begin{cases}(2-\frac{3}{2}b-c)|s|^3+(-3+2b+c)|s|^2+(1-\frac{1}{3}b), & |s|\le 1\\ (-\frac{1}{6}b-c)|s|^3+(b+5c)|s|^2+(-2b-8c)|s|+(\frac{4}{3}b+4c), & 1<|s|\le 2\\ 0, & \textit{Otherwise}\end{cases}$$

and wherein $b=0$ and $c=0.5$.

59. The computer readable medium according to claim 46, wherein said kernel is a linear interpolation kernel.

60. The computer readable medium according to claim 46, wherein said kernel is a universal linear interpolation kernel.

61. The computer readable medium according to claim 46, wherein said kernel is a quadratic interpolation kernel.

62. The computer readable medium according to claim 46, wherein said kernel is a weighted sinc interpolation kernel.